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APPLICATION FOR LETTERS PATENT

**Method and Apparatus for
Selecting Among Multiple Tuners**

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1 **TECHNICAL FIELD**

2 This invention relates to selecting among multiple tuners to tune a particular
3 channel.
4

5 **BACKGROUND OF THE INVENTION**

6 Existing televisions, set top boxes, and other devices that tune broadcast
7 signals contain a single tuner which is capable of tuning one of several different
8 channels contained in a broadcast signal. Since these existing device contain a
9 single tuner, they are not capable of tuning two or more different channels
10 simultaneously (without the help of an external tuning device). Thus, when a user
11 submits a request to change channels, the single tuner is instructed to change to the
12 requested channel. Since there is only one tuner, there is no question as to which
13 tuner will tune the requested channel.

14 However, with the development of televisions, set top boxes, and other
15 client devices that contain multiple tuners, issues arise regarding which tuner
16 should be used to tune a particular channel when a request to change channels is
17 received. For example, once a particular tuner begins tuning and recording a
18 program, that tuner cannot be used to tune any other channel without stopping the
19 recording process. If a request to change channels is received while a particular
20 channel is being recorded, the system must determine whether the user desires to
21 stop the recording and view the new channel or to continue recording the previous
22 channel while viewing the new channel. Repeatedly prompting the user to select a
23 tuner to tune a particular channel is likely to be frustrating and distracting to the
24 user.
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1 Therefore it is desirable to provide a system that selects among multiple
2 tuners to tune a particular channel in a manner that is least intrusive to the user of
3 the system.

4 5 **SUMMARY OF THE INVENTION**

6 The systems and methods described herein select among multiple tuners to
7 tune a requested channel. These systems and methods require little or no input
8 from the user as to which tuner should be assigned to tune a particular channel.
9 For example, if a new channel is selected by the user and a tuner is available to
10 tune the new channel, the available tuner is automatically assigned to tune the new
11 channel without requiring any user input or otherwise disrupting the channel
12 selection process.

13 In a particular embodiment, a request is received to tune a first channel. A
14 first tuner is assigned to tune the first channel. Another request is received to tune
15 a second channel. The first tuner is assigned to tune the second channel if the
16 program tuned by the first tuner is not being recorded. The second tuner is
17 assigned to tune the second channel if the program tuned by the first tuner is being
18 recorded.

19 Another embodiment receives a request to record a program on a first
20 channel. A first tuner is assigned to tune the first channel. Another request is
21 received to tune a second channel. A determination is made regarding whether the
22 second channel is already being tuned. Another determination is made regarding
23 whether a second tuner is available for tuning. The first tuner is assigned to tune
24 the second channel if the second channel is not already being tuned and the second
25 tuner is not available for tuning. The second tuner is assigned to tune the second

1 channel if the second channel is not already being tuned and the second tuner is
2 available for tuning.

3 According to one aspect of the invention, the system switches to the tuner
4 assigned to the second channel if the second channel is already being tuned.

5 6 7 **BRIEF DESCRIPTION OF THE DRAWINGS**

8 The same reference numerals are used throughout the drawings to reference
9 like components and features.

10 Fig. 1 illustrates an exemplary environment in which the methods and
11 systems described herein may be implemented.

12 Fig. 2 is a block diagram of an example client device, a television, and
13 various input devices that interact with the client device.

14 Fig. 3 is a block diagram of selected components of the client device shown
15 in Figs. 1 and 2.

16 Fig. 4 is a block diagram of an exemplary client device that includes two
17 tuners, a tuner controller, a disk drive, and a pair of decoders.

18 Fig. 5 is a flow diagram illustrating an embodiment of a procedure for
19 determining which tuner to use when a user selects a new channel to view.

20 Fig. 6 is a flow diagram illustrating an embodiment of a procedure for
21 determining which tuner to use when one tuner is recording a program and a
22 change channel command is received.

DETAILED DESCRIPTION

Fig. 1 illustrates an exemplary environment 100 in which the methods and systems described herein may be implemented. One or more content providers 102 include stored content 118 and a content server 120. Content server 120 controls the movement of content (including stored content 118) from the content provider 102 to a content distribution system 104, which is coupled to the content provider. Additionally, the content server 120 controls the movement of live content (e.g., content that was not previously stored by the content provider) and content stored at other locations to the content distribution system.

The content distribution system 104 contains a broadcast transmitter 122 and one or more content processors 124. Broadcast transmitter 122 broadcasts signals (e.g., cable television signals) across a broadcast network 116, such as a cable television network. Broadcast network 116 may include wired or wireless media using any broadcast format or broadcast protocol. Content processor 124 processes the content received from content provider 102 prior to transmitting the content across the broadcast network 116. A particular content processor may encode or otherwise process the received content into a format that is understood by multiple client devices 106 coupled to the broadcast network 116. Although Fig. 1 shows a single content provider 102 and a single content distribution system 104, a particular environment may include any number of content providers coupled to any number of content distribution systems.

A client device 106(1) receives broadcast content from a satellite-based transmitter via a satellite dish 110. Client device 106(1) is also referred to as a set-top box, game console or a satellite receiving device. Client device 106(1) is coupled to a television 108(1) for presenting the content received by the client

1 device (i.e., audio data and video data) as well as a graphical user interface. A
2 particular client device 106 may be coupled to any number of televisions 108.
3 Similarly, any number of client devices 106 may be coupled to a television 108.
4 Another client device 106(2) is coupled to receive broadcast content from
5 broadcast network 116 and provide the received content to a television 108(2).
6 Another client device 106(N) is a combination of a television 112 and a set-top
7 box 114. In this example, the various components and functionality of the set-top
8 box are incorporated into the television, rather than using two separate devices.
9 The set-top box incorporated into the television may receive broadcast signals via
10 a satellite dish (similar to satellite dish 110) and/or via broadcast network 116. In
11 alternate embodiments, client devices 106 may receive broadcast signals via the
12 Internet or any other broadcast medium.

13 Fig. 2 is a block diagram of an example client device 106, television 108,
14 and various input devices that interact with the client device. As discussed above,
15 client device 106 may also be referred to as a set-top box, a game console or a
16 satellite receiver. Client device 106 includes a wireless receiving port 202 (e.g., an
17 infrared (IR) wireless port) for receiving wireless communications from a remote
18 control device 204, a handheld device 206 (such as a personal digital assistant
19 (PDA) or handheld computer), or other wireless device, such as a wireless
20 keyboard. Additionally, a wired keyboard 208 is coupled to client device 106 for
21 communicating with the client device. In alternate embodiments, remote control
22 device 204, handheld device 206, and/or keyboard 208 may use an RF
23 communication link (or other mode of transmission) to communicate with client
24 device 106.
25

1 Client device 106 receives one or more broadcast signals 220 from one or
2 more broadcast sources (e.g., from a broadcast network or via satellite). Client
3 device 106 includes hardware and/or software for receiving and decoding
4 broadcast signal 220, such as an NTSC, PAL, SECAM or other TV system video
5 signal, and providing video data to the television 108. Client device 106 also
6 includes hardware and/or software for providing the user with a graphical user
7 interface by which the user can, for example, access various network services,
8 configure the client device 106, and perform other functions.

9 Client device 106 receives AC power on line 110. Client device 106 is
10 capable of communicating with other devices via a conventional telephone link
11 212, an ISDN link 214, a cable link 216, and an Ethernet link 218. A particular
12 client device 106 may use any one or more of the various communication links
13 212-218 at a particular instant. Client device 106 also generates a video signal and
14 an audio signal, both of which are communicated to television 108. The video
15 signals and audio signals can be communicated from client device 106 to
16 television 108 via an RF (radio frequency) link, S-video link, composite video link,
17 component video link, or other communication link. Although not shown in Fig.
18 2, a particular client device 106 may include one or more lights or other indicators
19 identifying the current status of the client device. Additionally, a particular client
20 device 106 may include one or more control buttons or switches (not shown) for
21 controlling operation of the client device.

22 Fig. 3 is a block diagram of selected components of the client device 106
23 shown in Figs. 1 and 2. Client device 106 includes multiple tuners 300 and 302,
24 one or more processors 304, a random access memory (RAM) 306, and a non-
25 volatile memory 308 that contains, for example, an operating system 310 and one

1 or more application programs 312. Client device 106 also includes a disk drive
2 314 and storage media 316. Although client device 106 is illustrated having both a
3 RAM 306 and a disk drive 314, a particular device may include only one of the
4 memory components. Additionally, although not shown, a system bus typically
5 couples together the various components within client device 106.

6 Processor(s) 304 process various instructions to control the operation of
7 client device 106 and to communicate with other electronic and computing
8 devices. The memory components (e.g., RAM 306, disk drive 314, storage media
9 316, and non-volatile memory 308) store various information and/or data such as
10 configuration information and graphical user interface information.

11 Client device 106 also includes a decoder 318, such as an MPEG-2 decoder
12 that decodes MPEG-2-encoded signals. A modem 320 allows client device 106 to
13 communicate with other devices via a conventional telephone line. An IR
14 interface 322 allows client device 106 to receive input commands and other
15 information from a user-operated device, such as a remote control device or an IR
16 keyboard. Client device 106 also includes a network interface 324, a serial/parallel
17 interface 326, an audio output 328, and a video output 330. Interfaces 324 and 326
18 allow the client device 106 to interact with other devices via various
19 communication links. Although not shown, client device 106 may also include
20 other types of data communication interfaces to interact with other devices. Audio
21 output 328 and video output 330 provide signals to a television or other device that
22 processes and/or presents the audio and video data. Although client 106 is
23 illustrated having multiple interfaces, a particular client may only include one or
24 two such interfaces.

1 Client device 106 also includes a user interface (not shown) that allows a
2 user to interact with the client device. The user interface may include indicators
3 and/or a series of buttons, switches, or other selectable controls that are
4 manipulated by a user of the client device.

5 General reference is made herein to one or more client devices, such as
6 client device 106. As used herein, "client device" means any electronic device
7 having data communications, data storage capabilities, and/or functions to process
8 signals, such as broadcast signals, received from any of a number of different
9 sources.

10 Fig. 4 is a block diagram of a portion of an exemplary client device that
11 includes two tuners, a tuner controller, a disk drive, and a pair of decoders. The
12 exemplary client device contains additional components (such as those shown in
13 Fig. 3) which are omitted from Fig. 4 to simplify discussion of specific
14 components. A pair of tuners 402 and 404 each receive broadcast signals from a
15 one or more broadcast sources. Certain broadcast signals may include encoded
16 data, such as encoded video data and encoded audio data. In this situation, a
17 decoder is used to decode the encoded data.

18 In a particular embodiment, the broadcast signals include data encoded
19 using the MPEG-2 (Moving Pictures Experts Group) encoding format. MPEG-2 is
20 a standard for digital video and digital audio compression. MPEG-2 supports a
21 variety of audio/video formats, including legacy TV, HDTV (High-Definition
22 Television), and five channel surround sound. However, the methods and systems
23 described herein can be used with any type of signal using any type of encoding
24 format as well as signals that do not use any encoding.

1 Referring again to Fig. 4, each tuner 402 and 404 maintains an internal
2 "state". This state information may include, for example, the channel currently
3 being tuned (if any) and whether the tuner is creating a pause buffer (e.g., for
4 "pausing" a live broadcast) or creating an archival recording of the program. Each
5 tuner 402 and 404 is coupled to a tuner controller 406. Tuner controller 406
6 receives user control inputs, such as a user request to change channels or record a
7 program being broadcast on a particular channel. These user control inputs may be
8 provided through a remote control device, wireless keyboard, or other input
9 device. Tuner controller 406 processes the received user control inputs and sends
10 control instructions, if necessary, to tuner 402 and/or tuner 404. For example, if
11 the user requests to change from viewing channel 204 to channel 206, the tuner
12 controller 406 instructs one of the tuners 402 or 404 to begin tuning channel 206.
13 Additionally, tuners 402 and 404 can communicate information to tuner controller
14 406, such as the current channel being tuned by the tuner. Although two tuners are
15 illustrated in Fig. 4, a particular implementation may contain any number of tuners.

16 A disk drive 408 is coupled to tuners 402 and 404, tuner controller 406, and
17 a pair of decoders 410 and 412. Disk drive 408 is capable of storing program data
18 received from tuner 402 and/or 404 and replaying that program data at a later time.
19 Tuner controller 406 controls the recording of programs by sending appropriate
20 commands to disk drive 408. Disk drive 408 may also store other information
21 used by the client device such as configuration information. Disk drive 408
22 outputs encoded program content to decoder 410 and/or 412. The decoder 410,
23 412 then decodes the encoded program content and outputs decoded signals, such
24 as decoded video signals and decoded audio signals. Tuners 402 and 404 are also
25 coupled to decoders 410 and 412 and may provide tuned signals directly to

1 decoder 410, 412 if the tuned signal is being watched live (i.e., not being played
2 back from the disk drive 408). Although Fig. 4 illustrates two decoders 410 and
3 412, alternate embodiments include a single decoder that decodes signals from
4 both tuners 402 and 404, or from disk drive 408.

5 Alternatively, disk drive 408 may output signals directly (i.e., not through
6 decoder 410, 412) if the program content stored on the disk drive does not require
7 decoding. Similarly, tuners 402, 404 may output signals directly if the program
8 content being tuned does not require decoding.

9 Fig. 5 is a flow diagram illustrating an embodiment of a procedure 500 for
10 determining which tuner to use when a user selects a new channel to view.
11 Initially, a user selects a channel to view (block 502). A first tuner is assigned to
12 tune the channel selected by the user (block 504). The user then selects a new
13 channel to view (block 506). The procedure 500 then determines whether the
14 program being tuned by the first tuner is being recorded (block 508). This
15 determination can be performed by querying the state of the first tuner to
16 determine whether the program is being recorded. If the program being tuned by
17 the first tuner is not being recorded, the procedure assigns the first tuner to tune the
18 new channel (block 510). If the program being tuned by the first tuner is being
19 recorded, the procedure assigns a second tuner to tune the new channel (block
20 512). The manner in which a tuner is selected for the new channel minimizes
21 disruption to the user of the client device. For example, if the client device is
22 already recording a program on one channel, that recording is not disturbed by the
23 user's request to view a different channel. Instead of changing the channel
24 assigned to the tuner that is tuning the recorded channel, a second tuner is used to
25 tune the new channel.

1 Fig. 6 is a flow diagram illustrating an embodiment of a procedure 600 for
2 determining which tuner to use when one tuner is recording a program and a
3 change channel command is received. Initially, a user selects a channel to record
4 (block 602). A first tuner is assigned to tune the selected channel (block 604).
5 The user then selects a new channel to view (block 606). The procedure 600 then
6 determines whether the new channel is already being tuned by another tuner (block
7 606). If the new channel is already being tuned by another tuner, then block 610 of
8 the procedure switches to the tuner assigned to the new channel (i.e., the new
9 "active" tuner is the tuner that was already tuning the newly selected channel).
10 The procedure then awaits the next user input (block 618). If the "new channel"
11 was being recorded, the user is provided with a graphical indication on the
12 television screen and/or an audible sound indicating that the program is being
13 recorded.

14 By checking to see if the requested channel is already being tuned by
15 another tuner, the system maintains the highest number of available tuners and
16 avoids the situation where one tuner is recording a program from a particular
17 channel and another tuner is being used to tune and display the program from the
18 same channel. Also, by switching back to a tuner that is tuning and recording the
19 requested channel, the user has access to the previously recorded program content.
20 Certain systems empty the "pause buffer" (i.e., recorded portions of the program)
21 in response to a channel change. If a new tuner was used to tune and display the
22 selected channel, the previously recorded portions of the program would not be
23 available to the user. However, by switching control to the tuner already recording
24 the content, the user has access to the recorded content.

1 When switching back to a channel that is being recorded, the system can
2 begin displaying the program content currently being tuned by the tuner.
3 Alternatively, the system can begin displaying previously recorded program
4 content, such as playing back the recorded program starting at the beginning of the
5 program or playing back the recorded program from the point at which the user
6 previously changed channels (i.e., switched away from the recorded program).

7 Referring again to Fig. 6, if the new channel selected at block 606 is not
8 already being tuned by another tuner, the procedure 600 determines whether a
9 second tuner is "available" for tuning the new channel (block 612). An
10 "available" tuner as used herein may be defined in several different ways. An
11 "available" tuner may be idle or may be engaged in a task that has a lower priority
12 than the priority of allowing a user to change a channel being viewed. For
13 example, using the tuner to receive non-urgent data may be a lower priority than
14 changing a viewed channel, but using the tuner to record a second program may be
15 a higher priority than changing a viewed channel. One tuner can determine
16 whether another tuner is available by querying the other tuner to determine its
17 status and priority.

18 If a second tuner is not available for tuning the new channel, then the
19 procedure changes the first tuner to the new channel (block 614). The procedure
20 then awaits the next user input (block 618). If a second tuner is available for
21 tuning the new channel, then the procedure assigns the second tuner to the new
22 channel (block 616). The procedure then awaits the next user input (block 618).

23 In a particular embodiment, recorded program content is associated with the
24 tuner that originally tuned the recorded program. When a first tuner is tuning
25 program content that is being recorded and a problem occurs with the first tuner or

1 a higher priority task is assigned to the first tuner, a new tuner is selected to tune
2 the program. In this situation, the recorded program content may be changed such
3 that the recorded program content is associated with the new tuner. Thus, the user
4 is still able to view the previously recorded program content (tuned by the first
5 tuner) even though the first tuner is no longer available. For example, if the first
6 tuner malfunctions or the signal line providing broadcast signals to the first tuner is
7 damaged, the tuning operation is switched to a second tuner and the previously
8 recorded program content is modified to be associated with the new tuner.
9 Alternatively, the program content tuned by the second tuner may be stored as a
10 separate file that is "linked" to the previously recorded program content. By
11 linking the two files, the user is able to easily access the entire recorded program
12 content even though the program content is saved in two different files.

13 In one embodiment, one or more user interface features are provided that
14 indicate to the user that, upon switching back to a channel that is being recorded,
15 the user is now watching a recorded show. This indication reassures the user that
16 their recording is proceeding properly. This indication also reminds the user that
17 they have the ability to access previously recorded portions of the program, if
18 desired.

19 Portions of the systems and methods described herein may be implemented
20 in hardware or a combination of hardware, software, and/or firmware. For
21 example, one or more application specific integrated circuits (ASICs) or
22 programmable logic devices (PLDs) could be designed or programmed to
23 implement one or more portions of the systems and procedures described herein.

24 Although the invention has been described in language specific to structural
25 features and/or methodological steps, it is to be understood that the invention

1 defined in the appended claims is not necessarily limited to the specific features or
2 steps described. Rather, the specific features and steps are disclosed as preferred
3 forms of implementing the claimed invention.
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